Application of heat to a screen or mesh covering a gutter, specifically to melt snow or ice.

Background to the Invention

This invention concerns the provision of heat to a screen covering the guttering on the roof of a house or other building.

Mesh materials are commonly installed as screens over guttering along the edge of building roofs for the purpose of preventing the entry of unwanted materials such as sticks, leaves, and other tree debris, large insects, litter and the like into the guttering while still allowing water to flow from the roof into the guttering. In some places such guttering is called a gutter or spouting, but the general shape remains the same being an open topped channel, usually made of metal or plastics material, positioned to collect rainwater as it runs off a roof and gently sloped to deliver the collected water to one or more discharge points, usually downwardly directed downpipes.

It is well known that the collection of unwanted materials in guttering causes overflowing of the guttering, blockage of the outflow pipes, constitutes a fire hazard and contributes to corrosion of the guttering. It also contaminates any water collected from the roof for drinking or other domestic purposes.

Many systems are in use, and more have been proposed, which provide a screen of mesh to cover the top of the guttering. Some of these systems require the mesh to be tensioned between rigid fastenings on the roof and the top outer edge of the guttering. Such mesh must be kept somewhat tensioned in order for the leaves and sticks to slide over the edge of the gutter. The present invention is particularly adapted to such systems.

Many types of mesh have been used to produce a screen which successfully excludes foreign matter from guttering. Types of mesh that have been tried include punched metal, expanded (slit) metal, woven wire meshes and fibreglass flyscreen fabric. However in recent years moulded plastic meshes have been the most widely used.

However such meshes can bring disadvantages in regions prone to snowfall. As snow builds up, its weight can create substantial downwards pressure on the mesh, so causing it to stretch or tear or otherwise distort its fastenings to the roof or guttering. But if the mesh is not retained in a slight tension, the appearance and effectiveness of the mesh is reduced as the mesh sags into the gutter and does not shed the foreign material as readily. The present invention provides a means of reducing the weight/duration of snow loading on such mesh.

Snow and ice sliding down along roofs and from roofs of buildings is a source of damage to the roofs, to the guttering along the edges of the roof to people and other objects below. Roof tiles are dislodged and/or broken, guttering is bent and supporting brackets pulled out. Large chunks falling commonly cause serious injury to people and damage motor vehicles and other items below. An object of some embodiments of the present invention is to reduce such damage even in instances where guttering does not require a screen over it to prevent entry of leaves and sticks.

Another problem with using mesh screening in snow-prone regions is that as snow which has packed onto a roof then slides off the roof in a sheet, the mesh can suffer substantial damage if the snow does not slip smoothly across it. An object of preferred embodiments of the present invention is to reduce the tendency of such damage by providing a relatively smooth upper surface on the mesh.

Most attempts to use meshes to cover guttering have used a mesh which is so coarse that much foreign material passes through. Although this material is often small enough to be flushed away without blocking downpipes and drains, it can build up in the guttering and can also contaminate the water if it is stored in tanks for drinking. Perhaps more importantly though is that such mesh is so coarse that sticks and leaf stems easily become caught in it. Trapped in this way, the materials so caught protrude up from the mesh thus creating a barrier to the escape of other debris and the mesh thus provides a solid anchor for the build-up of further debris around the guttering area on a roof.

But if a mesh is fine enough to screen out the desired level of fine materials, this commonly impacts adversely on the mesh's ability to allow water to pass through,

particularly at times of high rates of rainfall. An object of preferred embodiments of the present invention is to provide a mesh which has improved water transmission because sheeting of the water flow across the mesh is reduced and water is encouraged to break free from the underside of the mesh to fall into the gutter.

Some prior art proposes that a heated wire or tape be placed in the gutter to melt the snow therein. However such heating is somewhat distant from the roofline where heating would be most effective. Also as the heating means is in contact with the gutter, substantial heat loss occurs from conduction through the gutter material to the surrounding air instead of it being directed into melting snow/ice.

Summary of the Invention

In one aspect the present invention provides a screen applied to overlay a gutter on an outside edge of a roof of a building, said screen comprising a panel of generally planar mesh affixed along one edge of the panel to the roof and along the opposite edge of the panel to the top outside edge of the gutter, the mesh being formed of moulded plastics material and the panel having an electrically powered heating strand extending along the panel in the direction of said one edge of the panel.

The mesh is preferably formed of an electrically insulating polymer material. Preferably the heating strand is a wire having an electrically insulating coating thereon.

The heating strand may be integrally moulded into the mesh, may be threaded through the holes in the mesh or may be tied to the mesh. Alternatively it may be retained by being looped around, (or otherwise caught upon) free ends or protruberances formed on the mesh. Alternatively the strand may be retained by clips which are in turn themselves retained within holes in the mesh. Alternatively the strand may be retained by being clipped into a channel formed longitudinally in the mesh. The heating strand may be affixed to the mesh by being looped into or around itself through holes in the mesh.

In another aspect the invention provides a sheet mesh of plastics material for application upon or above a roof gutter to prevent the entry of unwanted materials into the gutter, said mesh comprising:

a first face and a second face on respective opposite sides of the mesh, and

a first array of parallel strands aligned in a first direction integrally moulded with a second array of parallel strands aligned substantially at right angles to the first array, said strands defining mesh apertures therebetween,

wherein a pair of ribs or strands in the first array are adapted to clasp therebetween an electrical resistance heating wire.

Preferably the mesh comprises:-

- a top face and a bottom face on respective opposite sides of the mesh,
- a first array of parallel strands hereinafter called longitudinal strands aligned in the direction of said one edge of the panel, and
- a second array of parallel strands hereinafter called lateral strands integrally moulded with and aligned at right angles to the first array,

said first and second arrays of strands defining mesh apertures therebetween extending from said top face to said bottom face.

Preferably the thickness of the longitudinal strands extends for substantially the full thickness of the mesh from said top face to said bottom face, and the thickness of the lateral strands extends along their full length, from said top face to less than 80% of the thickness of the mesh. The lateral strands are preferably spaced closer to each other than are the longitudinal strands.

Water flow through the mesh may be increased if strands in the mesh aligned in the direction of the gutter are formed to extend below the strands at right angles to them. But this introduces a series of contradictory performance requirements. In particular, if the mesh strands aligned longitudinally to the gutter project below the general plane of the mesh in order to facilitate water removal on the underside of the mesh, there is the adverse effect that this increased depth of longitudinal strand increases the longitudinal stiffness of the mesh so that it is difficult to bend along a tight radius during the important tailoring of the mesh to the profile of the roofing material during the installation process. Moulding

the mesh from an especially flexible plastics material would facilitate such bending, but this would be strongly detrimental to the necessary rigidity required for the lateral strands in the mesh which support the span of the mesh between the roof and the outer edge of the gutter. Conventionally a compromise would therefore be required whereby stiffness in the lateral direction would be compromised in order to obtain satisfactory flexibility in the longitudinal direction and flexibility in the longitudinal direction would be compromised in order to achieve sufficient stiffness in the lateral direction.

Accordingly, in some embodiments of the present invention the lateral strands are made from a stiffer material than that from which the longitudinal strands are made. Preferably the lateral strands are formed from a material having a greater elastic resilience than the material from which the longitudinal strands are made. Preferably the lateral strands are at least mostly high density polyethylene and the longitudinal strands are at least mostly low density polyethylene and the mesh is formed using a plastics co-extrusion process.

It is highly desirable that a mesh readily discards any leaf litter and the like which falls onto or is washed onto it. Non discarded material catches other material and also organically breaks down to drop fine material into the guttering. The invention therefore provides that the thickness of the longitudinal strands may extend for substantially the full thickness of the mesh from said top face to said bottom face, and the thickness of the lateral strands may extend along their full length from said top face to less than 80% of the thickness of the mesh. The mesh would accordingly have a smooth top face, with the longitudinal strands and the lateral strands extending through to the top face, while the bottom face would carry ridges aligned in the direction of the lateral strands. The lateral strands may be spaced closer to each other than are the longitudinal strands, and the apertures may have an oval shape with their longer axis parallel to the lateral strands.

Preferably the apertures have a longer axis having a length in the range 4.0 to 5.5mm and have a shorter axis having a length in the range 2.5 to 3.0mm. Preferably a flat strip portion lies along said opposite edge of the panel and parallel to the longitudinal strands, said strip portion being substantially flat on its top face which blends gently with said top face of the remainder of the mesh.

The affixation of the mesh to the gutter may be by screws through the flat strip portion, with or without an overlying metal strip. Alternatively the affixation of the mesh to the gutter may be by means of mated strips of a textile hook and loop fastening system adhered to said flat strip portion and to said top outside edge of the gutter.

In a further aspect the invention provides a method of reducing the downward force of snow upon a mesh screen extended above a gutter on an outside edge of a roof of a building for the purpose of preventing the entry of unwanted materials into the gutter, said screen comprising a panel of mesh in a generally planar form affixed along one edge of the panel to the roof and along the opposite edge of the panel to the top outside edge of the gutter, said method comprising applying, when snow is covering the mesh, an electric current to an electrical heating strand extending along the mesh in the direction of said one edge of the panel. The mesh is preferably formed of moulded plastics material.

The invention may also be applied for a similar purpose over the valley drains on the roofs of buildings.

Brief Description of the Drawings

In order that the invention may be more fully understood there will now be described, by way of example only, preferred embodiments and other elements of the invention with reference to the accompanying drawings where:

Figure 1 shows diagrammatically the general structure of an installation of a mesh to a tiled roof in accordance with one embodiment of the invention;

Figure 2 shows diagrammatically the general structure of an installation of a mesh to a corrugated sheet steel roof in accordance with a second embodiment of the invention;

Figure 3 is a top view of a portion of the mesh in Figures 1 and 2 and in accordance with a third embodiment of the invention;

Figure 4 is a section view of part of the mesh along A-A indicated in Figure 3;

Figure 5 is a section view of part of the mesh along B-B indicated in Figure 3;

Figure 6 is a section view of part of the mesh along C-C indicated in Figure 3;

Figures 7 and 8 show two views of a clip which may be used to affix heating strand to the mesh shown in Figures 3, 4 and 5;

Figure 9 shows portion of a modified form of the mesh shown in Figure 4 which is adapted for quickly affixing a heating strand; and

Figure 10 is a plan view of an installation of a mesh screen to a roof in accordance with a fourth embodiment of the invention.

Detailed Description of the Invention

Referring to the installation shown in Figure 1, the edge of a roof has roofing tiles 11, fascia 12, soffit 13 and gutter (also called guttering) 14. A panel 15 of mesh is fixed over the gutter 14 to prevent the entry of unwanted materials while allowing the free flow of water through the mesh and into the gutter 14. The panel 15 is formed by unrolling a roll of mesh along the length of the guttering 14 and attaching one edge 33 of the mesh to the roof and the other edge 34 to the guttering. The panel 15 is attached to the roof by the weight of the second bottom row of tiles 11 and to the guttering by means described later in this specification. A rounded lip 18 forms the top outside edge of the guttering 14 and lies at the top of the guttering's outer face 20. The mesh is flexible enough for the panel to easily bend to the profile of the roofing tiles 11 so that the tiles continue to be located by correct engagement with neighbouring tiles. A similar configuration of installation may be used for a shingle roof.

Referring to Figure 2, wherein the roof is made from corrugated sheet steel 21, a first long edge 33 of the mesh panel 25 is cut and tailored and attached to the roof with appropriate cleats or clips 23 screwed through the mesh at the ridge tops of every second corrugation

and wings on the cleats 23 press the mesh down into each corrugation valley of the roof metal. The opposite long edge 34 of the mesh is attached to the outer lip 28 of the guttering by clamping the outer edge of the mesh between the outer lip 28 of the guttering and a length of angle trim 26 which is screwed at intervals to the lip 28.

In the case (not shown in the Figures) of a roof with a metal tray or deck cladding, the mesh panel would be cut at each high point of the cladding profile, fixed to the roof by screwing the mesh to the sides of the ribs of the profile, and the edges sealed to the pan of the profile by means of silicone sealant.

A preferred form of the mesh 15 is shown in more detail in Figures 3 to 6. The mesh has the form of a semi-rigid sheet formed from a plastics material (preferably UV stabilised polyethylene) and is provided in a roll of constant width which would preferably be within the range of 25 cm to 100 cm wide , the actual width depending on the particular application. The mesh as installed has a top face 38 and bottom face 40.

Parallel strands 42 of the mesh material in a first array run longitudinally of the mesh so when it is installed, the strands 42 run in the direction of the length of the guttering 14. Parallel strands 44 in a second array run laterally of the mesh so, when installed, they run in the direction of the width of the guttering. Figure 4 is cross-section A-A indicated in Figure 3 and this runs along the centre line of one of the lateral strands 44. Figure 5 is cross-section B-B indicated in Figure 3 and this runs along a line halfway between two lateral strands 44.

The intersecting strands 42 and 44 define between them apertures 48 through which the water flows into the gutter 14. Running longitudinally and centrally of the mesh is a strand of electrically insulated resistance heating wire 50. The wire is attached by looping it through apertures 48 at appropriate intervals and intertwining/knotting the wire to its own loops in the general manner of a crochet construction, and is best seen in Figure 6. Figure 6 is a stylised representation, somewhat different from actual appearance, in order to more clearly show the path taken by the wire. Such a construction results in there being two effective rows 51 of wire 50 above the strands 44, and one row 52 of wire 50 below the strands 44. All the rows 51 and 52 in combination comprise a single convoluted path of a

single length of wire. An appropriately shaped hook would be used to accomplish this looping and knotting procedure whereby the wire 50 is linked with this mesh.

The heating of the wire 50 may be achieved by connection to any suitable voltage such as 120-250 volt mains power, but is preferably by a lower voltage such as 6 to 24 volt. The wire is preferably a standard type of resistance heating type cable fully surrounded by an extruded UV-protected plastic cover, such as HDPE or PVC. The wire 50 is preferably heated at a rating of about 24w/m but this value could be from about 1w/m to 50w/m as suited to the particular situation.

The wire is preferably fastened to the mesh at the time the mesh is first installed over the gutter. For mains-voltage operation, an appropriately certified electrician would oversee the installation and electrical connection using appropriate safety circuit breakers to react if the wire becomes damaged; but this degree of protection may not be required if a low voltage connection is chosen.

Referring now to Figures 7 and 8, a clip 54 is shown which provides an alternative means of attaching the strand 50, which has the form of a wire, to the mesh. The clip 54 is a plastic moulding having an oval shaped base 56 attached to one end of a neck portion 58 at the other end of which are two arms 60 sized to snugly engage and retain the strand 50 between them. The longer axis of the oval base 56 is set at right angles to the direction of spread of the arms 60. In use the base 56 of such a clip is inserted upwards, fron the face 40 to the face 38, through an oval aperture 48 in the mesh, and then turned through 90° before the wire 50 is clipped into engagement between the arms 60. The neck 58 has a length which matches the thickness of the mesh. This embodiment has the advantage that the wire 50 remains completely below the mesh where it is less likely to be caught by moving snow.

Referring to Figure 9, one of the longitudinal strands 42 is modified such that it is longitudinally bifurcated having two ribs 43 defining a channel 45 therebetween into which the wire 50 may be clipped.

An alternative method of attaching the wire 50 to the mesh is to simply thread it up and down through the mesh along its length.

Another embodiment of the invention is shown in Figure 10. The panel 64 of mesh extends between the roof 21 and the outer lip of the guttering where it is held in place by the angle trim 26. Heating wire 62 is fastened to the mesh such that it adopts a zig-zag path 63 back and forth across the panel 64 at an angle of approximately 45° to the direction of the guttering. The wire may be fastened to the mesh by interweaving generally in the manner described above with reference to Figure 6, or by clips as shown in Figures 7 and 8, or by any other suitable means.

With the wire 62 tracking back and forth across the width of the mesh panel 64 in this manner, the snow and ice tends to melt into smaller chunks which are not as dangerous or damaging if/when they slide off the roof.

The electric current may be passed through the wire 50 in either a constant or pulsed manner. The source may be a low voltage, such as 6 or 12 volts for example, or may be a much higher voltage such as that used by an electric fence.

The longitudinal strands 42 extend for the full thickness of the mesh; that is for their full length they occupy the full depth between the top face 38 and bottom face 40 of the mesh. The lateral strands 44 extend from the top face 38 down about halfway to the bottom face. In other embodiments the depth of the lateral strands 44 may be up to 80% of the thickness of the mesh and down to as little as 20% of the thickness. Preferably the depth of the lateral strands is between 30% and 70% of the depth of the longitudinal strands.

Referring in particular to Figures 3, 4 and 5, running along the gutter-side edge 34 of the mesh is a flat strip portion 46. This is approximately 20mm wide and its thickness is approximately equal to the depth of the lateral strands 44. The top face 38 of the mesh is smooth and flat apart from minor irregularities due to non-uniform shrinkage of the plastics material as it solidifies during manufacture. Such shrinkage is somewhat greater at the longitudinal strands due to their greater depth. The strip 46 provides physical reinforcement to the outer edge 34 of the mesh and also provides a strengthened region for

the means by which the mesh is affixed to the lip 18 of the guttering. Preferably the flat strip portion 46 is not perforated.

The longitudinal strands 42 have a generally trapezoidal cross-section as best seen in Figure 5 while the lateral strands 44 have a generally semi-circular cross-section as seen in Figure 6. Where the strands 42 and 44 intersect, that intersection is heavily gusseted in the plane of the mesh thus rounding off the corners of the holes. The apertures 48 in the mesh are accordingly of a generally elliptical or oval shape and their longer axis is aligned in the direction of the lateral strands. The gusseting provides a strengthening feature to the mesh which increases its resistance to tearing and/or splitting. The oval shaped aperture, with its alignment in the direction of water flow, provides good water transmission through the mesh and reduces the incidence of entry of pine needles.

Typical dimensions for the mesh are:

centre to centre spacing of longitudinal strands 42	7.0 to 8.5mm and preferably 7.5mm
centre to centre spacing of lateral strands 44	4.5 to 5.5mm and preferably 5.0mm
depth of longitudinal strands 42	2mm
depth of lateral strands and flat strip portion	1mm
major axis of apertures 48	4.0 to 5.5mm
minor axis of apertures 48	2.5 to 3.0mm

The smooth top face 38 on the mesh is particularly advantageous. It should be appreciated that the whole of the surface that can be seen in Figure 3 is substantially flat. The smoothness of the top face provides outstanding "slip-off" of debris and minimises the possibility of sliding snow catching on the mesh and so damaging it. Experiments have indicated that a 60% improvement in "slip-off" of pine needles is achieved by this mesh compared with a corresponding mesh where the strands form a rippled or ridged top surface. Any deviation from flatness (for example that caused by differential shrinkage during manufacture) is preferably kept to less than 0.25mm.

The ridged bottom face 40 on the mesh provides a substantial advantage in that the water flow down the underside of the mesh is substantially disturbed from a smooth flow and each longitudinal strand 42 provides a break-off point for the water flow.

A suitable material for the mesh is produced by a co-extrusion process whereby the second array (lateral strands 44) is moulded from a less flexible material than the first array (longitudinal strands 42). A particularly desirable combination of materials is for the shallower strands 44 (ie those running across the width of the guttering) to be moulded from high density polyethylene (HDPE) while the strands 42 extending in the direction of the gutter are moulded from a mixture of low density polyethylene (LDPE) and HDPE in a co-extrusion process. By this means the mesh may be made stiffer in the lateral direction than in the longitudinal direction, despite the strands in the longitudinal direction having a deeper profile. The mesh thus has an improved resistance to sagging into the guttering.

In order to improve bonding of the two types of polyethylene, a small proportion of LDPE may be blended with the HDPE and/or a small proportion of HDPE may be blended with the LDPE. HDPE has a greater elastic resilience than LDPE. HDPE thus tends more to spring back to its originally moulded position whereas LDPE tends to more readily retain the shape to which it is bent during tailoring of the mesh to suit the profile of the roof to which it is installed.

In localities with a high fire danger, the mesh material preferably has a self-extinguishing fire retardant characteristic which desirably conforms to a fire rating of 3 under Australian Standard AS3959 when tested according to AS1530 Part 2.

In an alternative arrangement for fastening the panel 15 of mesh to the guttering, where the outer edge of the panel 15 of mesh reaches the outer lip 18 of the guttering 14 no angle trim or screws are employed to fix the mesh to the guttering. This is the fastening arrangement used in the embodiment shown in Figure 1. This fastening arrangement employs a mating pair of fastening strips of a textile hook and loop fastening system, an example of which is marketed under the trade mark Velcro. The fastening strips are held by adhesive to the top of the guttering lip 18 and to the underside of the strip portion 46 respectively and run continuously along the guttering and the mesh. The inner or roof side

edge of the mesh is first securely affixed to the roof in the conventional manner and the mesh is then tensioned across the guttering and pressed down to contact the mating strips of hook and loop textile.

In some embodiments the present invention may provide heat to continuously melt snow and ice overlying the mesh so as to gradually eliminate relatively large amounts. The melt would run through the mesh in many circumstances, but when the gutter freezes solid with ice, the melt water could flow over the outer lip of the gutter.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention includes all such variations and modifications which fall within its spirit and scope.

It will be also understood that where the word "comprise", and variations such as "comprises" and "comprising", are used in this specification, unless the context requires otherwise such use is intended to imply the inclusion of a stated feature or features but is not to be taken as excluding the presence of other feature or features.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that such prior art forms part of the common general knowledge of a person skilled in the art.